



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(54) Title:</b> PORTABLE RADIOTELEPHONES INCLUDING PATCH ANTENNAS <b>(57) Abstract</b> <p>A portable radiotelephone includes a transceiver, a processor, a speaker, a microphone, and a patch antenna. The transceiver transmits and receives radiotelephone communications, and the processor processes the radiotelephone communications transmitted and received by the transceiver. The speaker generates sound responsive to the received radiotelephone communications, the microphone generates electrical signals for the transmitted radiotelephone communications responsive to outside sound, and the patch antenna includes a conductive layer coupled to at least one of the processor and the transceiver. More particularly, the patch antenna can be a global position patch antenna that receives electromagnetic global position signals from a global position satellite.</p>		

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## PORTABLE RADIOTELEPHONES INCLUDING PATCH ANTENNAS

### Field of the Invention

The present invention relates to the field of communications and more particularly to radiotelephone communications.

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### Background of the Invention

It has been proposed to provide global positioning features in cellular radiotelephones. For example, U.S. Patent No. 5,235,633 to Dennison et al. discusses a cellular telephone system that uses the position of a mobile unit to make call management decisions. In particular, each mobile unit includes a global positioning system (GPS) receiver that receives information from a constellation of satellites to determine the precise location of the mobile unit. This position information is relayed to the cell site initially managing the mobile unit, and the mobile unit is handed off to a cell site that is most appropriate for the call.

15

In addition, U.S. Patent No. 5,625,668 to Loomis et al. discusses a positioning reporting cellular telephone. The cellular telephone of this patent includes a global positioning system (GPS) receiver and a cellular transceiver. In addition, a data processing facility converts latitude, longitude, velocity, and bearing information provided by the GPS receiver into meaningful descriptors that are spoken with a speech synthesizer. The disclosures of both of these patents are hereby incorporated herein in their entirety by reference.

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Portable radiotelephones including GPS receivers have typically used an additional antenna to provide GPS reception. For example, quadrafilair helix antennas extending from the radiotelephone body have been used. The size constraints on these antennas, however, may reduce the gain available using quadrafilair helix antennas. Moreover, these antennas may be oriented at less than ideal angles and/or may be too close to the user's body when used during telephone communications further reducing gain. Accordingly,

25

there continues to exist a need in the art for improved antennas for GPS receivers incorporated into radiotelephones.

### Summary of the Invention

5 It is therefore an object of the present invention to provide improved antennas for cellular radiotelephones.

It is another object of the present invention to provide improved antennas for cellular radiotelephones including GPS receivers.

These and other objects are provided according to the present  
10 invention by a radiotelephone including a patch antenna including a conductive layer for receiving electromagnetic signals. In particular, the patch antenna can be used to receive global position signals in a radiotelephone including global position (GPS) features. Accordingly, the patch antenna can be included in/on the radiotelephone body without significantly affecting the  
15 dimensions thereof.

In the past, patch antennas have not generally been used in portable radiotelephones because the vertical orientation of the radiotelephone against the user's head, as occurs during normal radiotelephone use, is not desirable for patch antenna reception and gain. The inventors have realized, however,  
20 that a patch antenna can be used advantageously during radiotelephone GPS operations because the radiotelephone can be held horizontally away from the user's head. Moreover, the patch antenna can be added to the radiotelephone without significantly affecting the dimensions of the radiotelephone because the patch antenna can be incorporated substantially  
25 parallel to a face of the radiotelephone body.

In particular, a portable radiotelephone according to the present invention can include a transceiver, a processor, a speaker, a microphone, and a patch antenna. The transceiver transmits and receives radiotelephone communications, and the processor processes the radiotelephone  
30 communications transmitted and received by the transceiver. The speaker generates sound responsive to the received radiotelephone communications, and the microphone generates electrical signals for the transmitted radiotelephone communications responsive to outside sound. The patch

antenna includes a conductive layer coupled to at least one of the processor and the transceiver.

More particularly, the patch antenna can be a global position patch antenna that receives electromagnetic global position signals from global position satellites, and the processor can include a global position receiver that determines a position of the radiotelephone based on the received electromagnetic global position signals.

The portable radiotelephone can include a radiotelephone body housing the speaker, the microphone, the transceiver, and the processor. In addition, an opening can be provided through the radiotelephone body adjacent the speaker to allow the generated sound from the speaker to pass therethrough, and the patch antenna can be located adjacent the speaker with an opening therein aligned with the opening in the face of the radiotelephone body to allow the generated sound from the speaker to pass therethrough.

Alternately, the patch antenna can have an opening therein aligned with another opening in the radiotelephone body to allow outside sound to pass through to the microphone. According to another alternative, the patch antenna can be adjacent to a keypad and have an opening therein aligned to allow a key of the keypad to move therethrough.

The radiotelephone can also include a display coupled to the processor wherein the processor generates a message on the display during global position calculations to encourage a horizontal orientation of the patch antenna. For example, the display might instruct the user to wait with the radiotelephone in a horizontal position held away from the user's body until the global position calculations have been completed.

The patch antenna can be provided, for example, by a conductive layer on a dielectric substrate inside the radiotelephone body. Alternately, the conductive layer can be provided on a surface of the radiotelephone body thereby eliminating the need for a separate dielectric layer. In other words, the radiotelephone body can be formed of a plastic that does not significantly attenuate the global position signals received from the global position satellites, and the conductive layer of the patch antenna can be formed as a part of the radiotelephone body. Furthermore, the conductive layer can be formed on either an inside or outside surface of the radiotelephone body.

Furthermore, the patch antenna can be provided on a flip portion of the radiotelephone body.

The radiotelephones, and methods of the present invention can thus be used to provide a global position antenna within a portable radiotelephone without significantly affecting the dimensions of the radiotelephone. The radiotelephones, and methods of the present invention can also provide improved reception of GPS signals.

### Brief Description of the Drawings

Figure 1 is a block diagram of a radiotelephone including a patch antenna according to the present invention.

Figure 2A is a perspective view of a radiotelephone including a patch antenna adjacent to a speaker according to the present invention.

Figures 2B-C are cross sectional views of alternate patch antenna structures for the patch antenna of Figure 2A.

Figure 3A is a perspective view of a radiotelephone including a patch antenna adjacent to a keypad according to the present invention.

Figures 3B-C are cross sectional views of alternate patch antenna structures for the patch antenna of Figure 3A.

Figure 4A is a perspective view of a radiotelephone including a patch antenna on a flip portion according to the present invention.

Figures 4B-C are cross sectional views of alternate patch antenna structures for the patch antenna of Figure 4A.

### Detailed Description

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the thicknesses of layers and regions of the cross sections are exaggerated for clarity. Like numbers refer to like elements throughout. It will also be

understood that when a layer is referred to as being "on" another layer or substrate, it can be directly on the other layer or substrate, or intervening layers may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present.

A cellular radiotelephone including a global positioning system (GPS) receiver according to the present invention is illustrated in Figure 1. As shown, the cellular radiotelephone includes a transceiver 21 for transmitting and receiving cellular radiotelephone communications through antenna 23, and a processor 25 for processing the communications transmitted and received by the transceiver 21. In addition, a user interface 27 is coupled with the processor, and the user interface can include a keypad 29, a display 31, a microphone 33, and a speaker 35. Accordingly, the radiotelephone can accept user speech through the microphone 33 for transmission to a radiotelephone communications system, and reproduce speech received from a distant party over the radiotelephone communications system using the speaker 35. Radiotelephone information can be provided to the user through the display 31, and user input can be accepted through the keypad 29.

In addition, the radiotelephone of the present invention includes a GPS receiver 37 and a GPS patch antenna 39. The GPS receiver 37 can thus accurately determine the geographic position of the radiotelephone, and provide the geographic information to the radiotelephone processor 25. Accordingly, this geographic information can be provided to the radiotelephone user either visually through the display 31 or audibly through the speaker 35. The geographic information can also be transmitted through the transceiver 21 and the antenna 23 to the radiotelephone communications system. For example, the geographic information can be transmitted during a "911" call to assist an emergency response by police, fire, and/or rescue personnel. The geographic information can also be used, for example, to make call management decisions as discussed in U.S. Patent No. 5,235,633, spoken with a speech synthesizer as discussed in U.S. Patent No. 5,625,668, or otherwise communicated to the user of the radiotelephone.

As will be understood by those having skill in the art, the GPS receiver 37, the transceiver 21, and the processor 25 can be provided separately as

shown in Figure 1. Alternately, two or more of these elements can be provided together. For example, the processor can be defined as including one or both of the GPS receiver and the transceiver, and/or the transceiver can be defined as including the GPS receiver. These elements are shown  
5 separately for the sake of clarity of this disclosure and not for purposes of limitation. Moreover, these elements can be provided individually or in combination as one or more custom and/or standard integrated circuit and/or discrete devices running firmware and/or software.

The radiotelephone of the present invention can include the GPS patch  
10 antenna without significantly affecting the dimensions of the radiotelephone. As shown in Figure 2A, the radiotelephone includes a body 41 housing the GPS patch antenna 39A, the display 31, the keypad 29, the microphone 33, and the antenna 23 as shown. In particular, the GPS patch antenna can include a conductive layer, such as a metal layer on a dielectric layer, wherein  
15 the conductive layer is approximately 1.0 inch square and the metal layer and the dielectric layer together have a thickness of approximately 0.2 inches. The housing also encloses the GPS receiver 37, the transceiver 21, the processor 25, and the speaker 35 which are not visible in the perspective view of Figure 2A.

20 The radiotelephone body includes a front face 43 which is held to the user's head when talking. Accordingly, the speaker 35 is mounted adjacent the front face 43, and holes 45 are provided in the front face adjacent the speaker to allow sound from the speaker to pass therethrough. Moreover, the microphone can be provided adjacent the front face with holes 47 being  
25 provided through the front face to allow sound to pass through to the microphone.

More particularly, the radiotelephone body of Figure 2A includes a moveable flip portion 49 which extends the front face 43 when opened as shown, and the microphone 33 can be included in the main portion of the  
30 radiotelephone body. A channel 51 through the flip portion 49 can be used to conduct sound from the holes 47 to the microphone 33. When closed, the flip portion 49 covers a portion of the radiotelephone body. The front face of the radiotelephone body can also include the display 31 and the keypad 29.



Accordingly, the flip portion 49 can cover the keypad and/or the display when closed.

According to the present invention, the patch antenna 39A includes a conductive layer substantially parallel to the front face of the radiotelephone body. With dimensions of approximately 1.0 inches square and 0.2 inches thick, the patch antenna can be incorporated in the radiotelephone of the present invention without significantly affecting the dimensions of the radiotelephone. As shown in Figure 2A, the patch antenna can be located adjacent the speaker with openings therein aligned with the openings 45 in the front face of the radiotelephone body to allow sound to pass therethrough. These relatively small openings (or holes) in the patch antenna can be provided without significantly affecting the antenna performance. Furthermore, the antenna can be tuned to compensate for the addition of these holes. Alternate arrangements of the patch antenna 39A are illustrated in the cross sections of Figures 2B-2C.

In Figure 2B, the patch antenna includes a conductive layer 53 on a dielectric layer 55 mounted between the speaker 35 and the front face 43 of the radiotelephone body. As shown, the openings 45 extend through the front face 43 of the radiotelephone body, the conductive antenna layer 53, the dielectric layer 55, and conductive ground layer 56. Accordingly, a conventional patch antenna can be used without significantly affecting the dimensions of the radiotelephone. Preferably, the front face of the radiotelephone body is formed from a plastic or other material which does not significantly attenuate the GPS signals (typically 1575.42 MHz) received by the patch antenna. A typical connection to a patch antenna is made with coaxial cable 58. The center conductor of 58 electrically connects to conductive antenna layer 53 and the ground shield of 58 electrically connects to conductive ground layer 56. It is usually good practice (but not necessary) to make the ground layer 56 of the patch as large as is convenient. The exact size and shape of layer 53 tunes the antenna. The exact placement of the connection between the patch antenna and coaxial cable 58 determines impedance matching and antenna polarization.

Accordingly to another alternative, shown in Figure 2C, the patch antenna can include a conductive antenna layer 53" formed on the outside

surface of the front face of the radiotelephone body opposite the speaker 35. In addition, a protective layer 57 can be formed on the conductive antenna layer 53" to reduce wear of the conductive layer. Here, the openings 45 extend through the protective layer 57, the conductive antenna layer 53", the front face 43, and conductive ground layer 56", allowing sound from the speaker to pass therethrough. The material and thickness of front face 43 should be consistent with the electrical characteristics of a patch antenna. The dielectric constant and thickness affect the size of layer 53" and the useable bandwidth of the antenna.

The GPS patch antenna 39A discussed above is thus oriented substantially parallel to the front face of the radiotelephone body. Accordingly, the radiotelephone is preferably held with the front face substantially parallel to the ground when receiving GPS signals from GPS satellites. This orientation can provide a circular polarization for the patch antenna that matches the circular polarization of signals transmitted by the GPS satellites. This orientation can be facilitated during GPS operations using messages on the display 31. For example, the processor can generate explicit instructions on the display to hold the telephone in the desired orientation (front face up and away from the user's body) while the location is being determined.

Alternately, this orientation can be encouraged more subtly so that the user is less likely to notice the delay of determining the location. In particular, the processor can generate any message on the display that will hold the user's attention. Because the phone is held in approximately the desired orientation when the user is reading the display, the patch antenna can receive the GPS signals used for location determination. Once the location has been determined, the processor can generate a message on the display instructing the user to continue with normal operations.

An alternate arrangement of the patch antenna 39B is illustrated in Figure 3A. In Figure 3A, the patch antenna 39B provided adjacent the keypad 29 including a plurality of keys 29a, key contacts 29b, PC board substrate 29c, and openings are provided through the front face 43 of the radiotelephone body and the patch antenna 39B to allow movement of the keys 29a therethrough and to allow contact between the keys 29a and the key

contacts 29b inside the radiotelephone body. As before, the radiotelephone also includes an antenna 23, openings 45 in the radiotelephone body allowing sound from the speaker to pass therethrough, a display 31, a microphone 33, a flip portion 49, and openings 47 and channel 51 allowing passage of sound to the microphone. Various patch antenna structures for patch antenna 39B are illustrated in Figures 3B-C.

As shown in Figure 3B, the patch antenna 39B can include a conductive antenna layer 63 on a dielectric layer 65, along with conductive ground layer 64 and coaxial cable 58 attached to layers 63 and 64, and the patch antenna can be mounted along the inside surface of the front face 43 of the radiotelephone body adjacent the keypad 29 including keys 29a. Openings through the front face 43, the conductive layer 63, the dielectric layer 65, and the ground layer 64 provide movement of the keys 29a therethrough as well as contact between the keys and the keypad PC board substrate 29c. The ground layer 64 of the patch antenna can be disrupted by keypad contacts (and traces) 29b with little impact. The center conductor of coaxial cable 58 connects to layer 63 and the shield of cable 58 connects to layer 64.

According to another alternative, the conductive layer 63" can be formed on the outside surface of the front face 43 of the radiotelephone body as shown in Figure 3C. In particular, the conductive layer 63" can be formed on the outside surface of the front face, and a protective layer 67 can be formed on the conductive layer 63". Openings through the front face, the conductive layer, the protective layer, and the conductive ground layer 64" provide for movement of the keys 29a and/or keypad contacts 29b therethrough.

Another alternate arrangement of the patch antenna 39C is illustrated in Figure 4A. In Figure 4A, the patch antenna 39C is provided on the flip portion 49 of the front face of the radiotelephone body, and openings are provided through the patch antenna 39C to allow passage of sound therethrough to the microphone 33. As before, the radiotelephone also includes an antenna 23, openings 45 in the radiotelephone body allowing sound from the speaker to pass therethrough, a display 31, a microphone 33, a flip portion 49, and openings 47 and channel 51 allowing passage of sound

to the microphone. Various patch antenna structures for patch antenna 39C are illustrated in the cross sectional views of Figures 4B-C.

As shown in Figure 4B, the patch antenna 39C can include a conductive antenna layer 73, a dielectric layer 75, and a conductive ground layer 76 adjacent the front face of the flip portion 49 of the radiotelephone body. Moreover, the openings 47 extend through the front face 43, the conductive layer 73, the dielectric layer 75, and conductive ground layer 76 allowing the conduction of sound therethrough to the channel 51 and the microphone 33. The electrical connection to patch antenna 39c is via coaxial cable 58. The center conductor of cable 58 connects to layer 73 and the shield of 58 connects to layer 76. Cable 58 can be routed physically in cavity 51.

As shown in Figure 4C, the conductive layers 73" and 76" along with dielectric layer 75 can be formed on the surface of the front face of the flip portion, and a protective layer 77 can be formed on the conductive layer. Again, the openings 47 through the protective layer 77, the conductive layers 73" and 76" and dielectric layer 75, and the front face of the flip portion allow conduction of sound therethrough to the channel 51 and the microphone 33.

In each of the patch antennas discussed above, the patch antenna can be provided without significantly affecting the dimensions of the radiotelephone. Moreover, holes in the patch antenna allow placement of the antenna adjacent the speaker, the microphone, or the keypad, and any affect of the holes on the performance of the patch antenna can be reduced by tuning the antenna. In addition, the patch antenna in the radiotelephone can provide circular polarization matching that of GPS signals transmitted by GPS satellites. The patch antenna of the present invention can thus provide improved performance over GPS antennas previously used in radiotelephones including GPS functions.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims. Furthermore, while radiotelephones including patch antennas according to the present invention have been discussed with

reference to cellular radiotelephones, the patch antennas of the present invention can be used with other radiotelephones such as satellite radiotelephones or dual mode radiotelephones capable of communicating with terrestrial and satellite communications systems, as well as radiotelephones  
5 capable of communicating with other types of terrestrial communications systems.

## THAT WHICH IS CLAIMED IS:

1. A portable radiotelephone comprising:
  - a transceiver that transmits and receives radiotelephone communications;
  - a processor coupled to the transceiver that processes the
  - 5 radiotelephone communications transmitted and received by the transceiver;
  - a speaker coupled to the processor that generates sound responsive to the received radiotelephone communications;
  - a microphone coupled to the processor that generates electrical signals for the transmitted radiotelephone communications responsive to outside
  - 10 sound; and
  - a patch antenna including a conductive layer coupled to at least one of the processor and the transceiver that receives electromagnetic signals.
2. A portable radiotelephone according to Claim 1 wherein the patch antenna comprises a global position patch antenna that receives electromagnetic global position signals from a global position satellite.
3. A portable radiotelephone according to Claim 2 wherein the processor comprises a global position receiver that processes the received electromagnetic global position signals.
4. A portable radiotelephone according to Claim 1 wherein the patch antenna has an opening therein to allow the generated sound from the speaker to pass therethrough.
5. A portable radiotelephone according to Claim 1 wherein the patch antenna has an opening therein to allow the outside sound to pass through to the microphone.
6. A portable radiotelephone according to Claim 1 further comprising:

a keypad having a key coupled to the processor, wherein the patch antenna is adjacent the keypad and wherein the patch antenna has an opening therein to allow movement of the key therethrough.

7. A portable radiotelephone according to Claim 3 further comprising:  
a display coupled to the processor, wherein the processor generates a message on the display during global position processing to encourage a horizontal orientation of the patch antenna.

8. A portable radiotelephone according to Claim 1 further comprising:  
a radiotelephone body housing the processor, transceiver, microphone and speaker, wherein the conductive layer is provided on a dielectric layer inside the radiotelephone body.

9. A portable radiotelephone according to Claim 1 further comprising:  
a radiotelephone body housing the processor, transceiver, microphone, and speaker, wherein the conductive layer is provided on a surface of the radiotelephone body.

10. A portable radiotelephone according to Claim 9 wherein the conductive layer is provided on an inside surface of a face of the radiotelephone body.

11. A portable radiotelephone according to Claim 9 wherein the conductive layer is provided on an outside surface of a face of the radiotelephone body.

12. A portable radiotelephone according to Claim 1 further comprising:  
a radiotelephone body housing the processor, transceiver, microphone, and speaker, wherein the radiotelephone body includes a flip portion that closes to cover a portion of the radiotelephone body and opens to extend the  
5 radiotelephone body wherein the patch antenna is located on the flip portion of the radiotelephone body.

13. A portable radiotelephone comprising:  
a radiotelephone body having face;  
a speaker within the radiotelephone body;  
a microphone within the radiotelephone body; and  
5 a patch antenna including a conductive layer substantially parallel to the face of the radiotelephone body.
14. A portable radiotelephone according to Claim 13 wherein the patch antenna comprises a global position patch antenna that receives global position signals from a global position satellite.
15. A portable radiotelephone according to Claim 13 wherein the patch antenna has an opening therein to allow sound from the speaker to pass therethrough.
16. A portable radiotelephone according to Claim 13 wherein the patch antenna has an opening therein to allow sound to pass through to the microphone.
17. A portable radiotelephone according to Claim 13 further comprising:  
a keypad having a key on the radiotelephone body wherein the patch antenna is adjacent the keypad and wherein the patch antenna has an  
5 opening therein allowing movement of the key therethrough.
18. A portable radiotelephone according to Claim 14 further comprising:  
a display on the radiotelephone body; and  
a processor in the radiotelephone body wherein the processor is  
5 coupled to the display and to the patch antenna to process the global position signals received from the global position satellite, and wherein the processor generates a message on the display during global position processing to encourage a horizontal orientation of the patch antenna.



19. A portable radiotelephone according to Claim 13 wherein the conductive layer is provided on a dielectric layer inside the radiotelephone body.

20. A portable radiotelephone according to Claim 13 wherein the conductive layer is provided on a surface of the radiotelephone body.

21. A portable radiotelephone according to Claim 20 wherein the conductive layer is provided on an inside surface of the radiotelephone body.

22. A portable radiotelephone according to Claim 20 wherein the conductive layer is provided on an outside surface of the radiotelephone body.

23. A portable radiotelephone according to Claim 13 wherein the radiotelephone body includes a flip portion that closes to cover a portion of the radiotelephone body and opens to extend the radiotelephone body wherein the patch antenna is located on said flip portion of the radiotelephone body.

24. A method of receiving global position satellite signals at a portable radiotelephone including a global position antenna and a global position receiver coupled to the global position antenna, the method comprising the step of:

5       generating a message during global position processing to encourage a desired orientation of the global position antenna.

25. A method according to Claim 24 wherein the global position antenna is a patch antenna including a conductive layer and wherein the desired orientation of the antenna is approximately horizontal.

26. A portable radiotelephone comprising:  
a transceiver that transmits and receives radiotelephone communications;

5       a processor coupled to the transceiver that processes the radiotelephone communications transmitted and received by the transceiver;

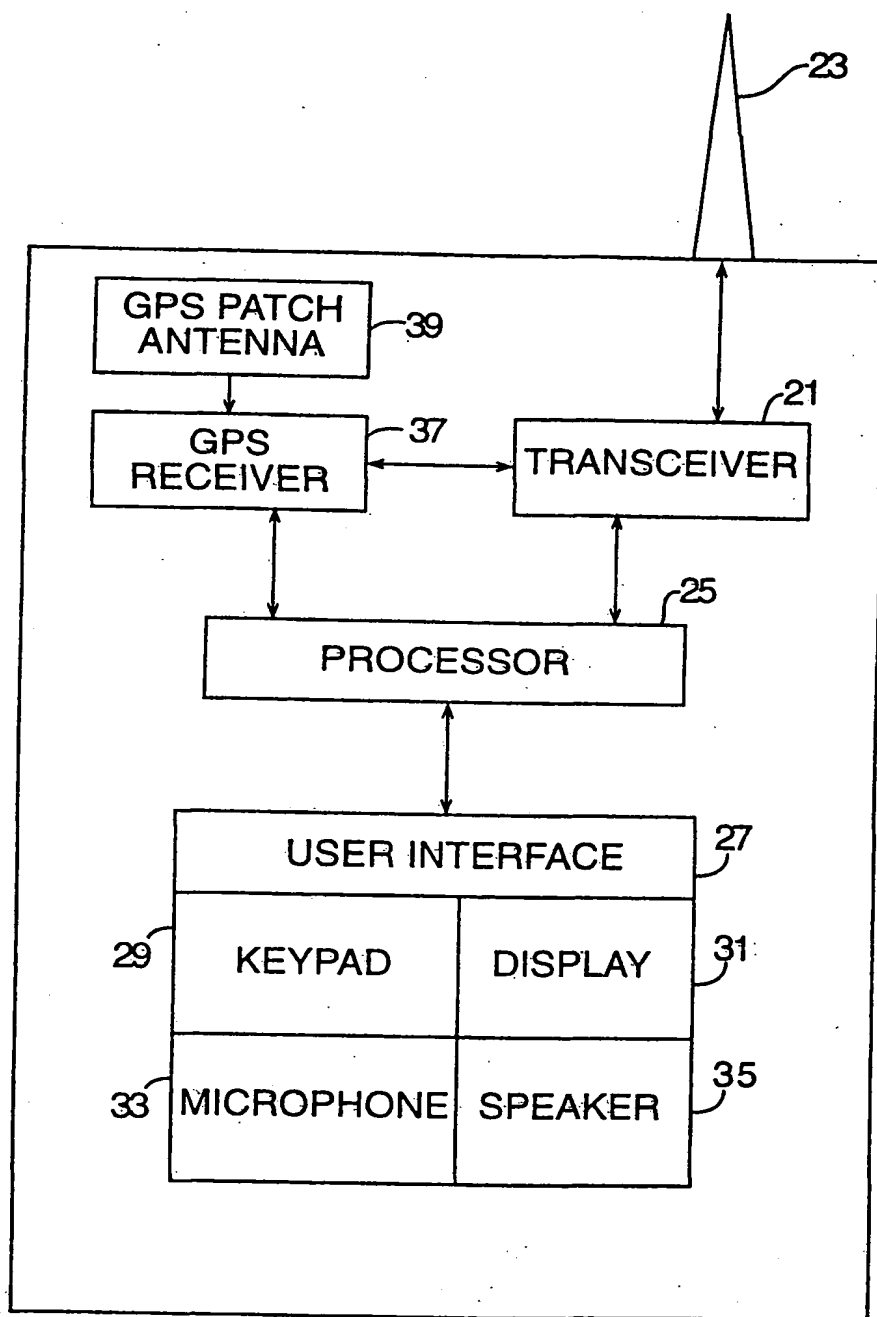
a speaker coupled to the processor that generates sound responsive to the received radiotelephone communications;

10 a microphone coupled to the processor that generates electrical signals for the transmitted radiotelephone communications responsive to outside sound;

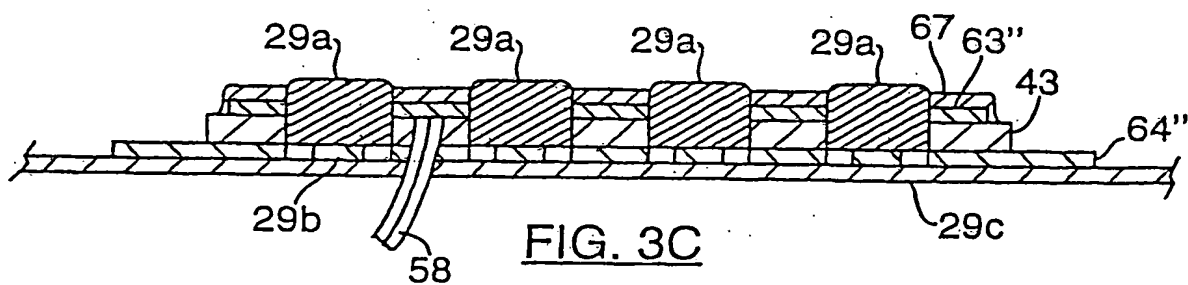
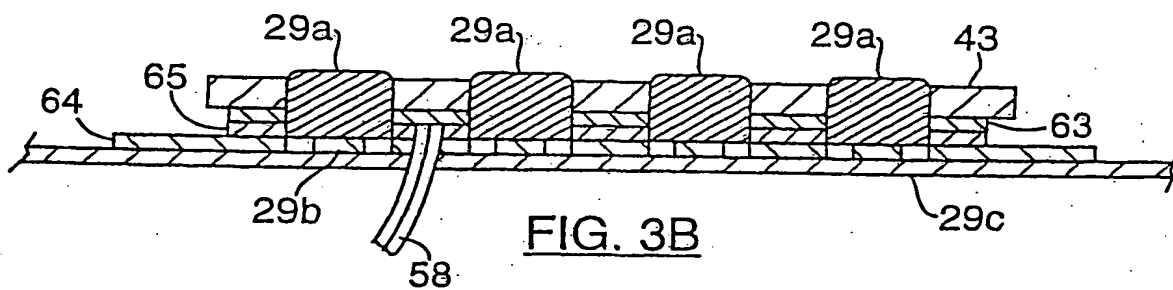
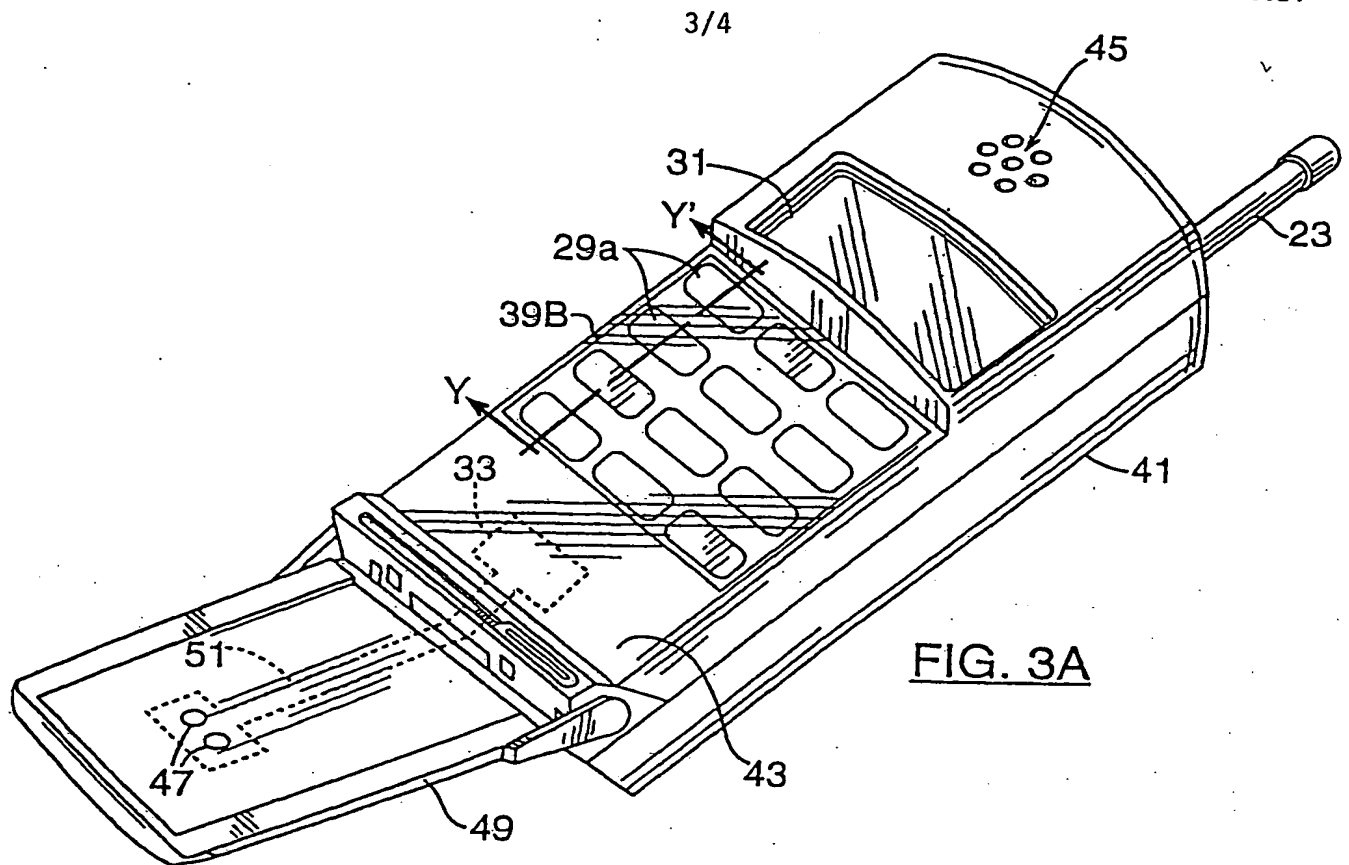
a global position antenna coupled to at least one of the processor and the transceiver that receives global position signals from a global position satellite wherein the processor comprises a global position receiver that processes the received global position signals; and

15 a display coupled to the processor wherein the processor generates a message on the display during global position processing to encourage a desired orientation of the global position antenna.

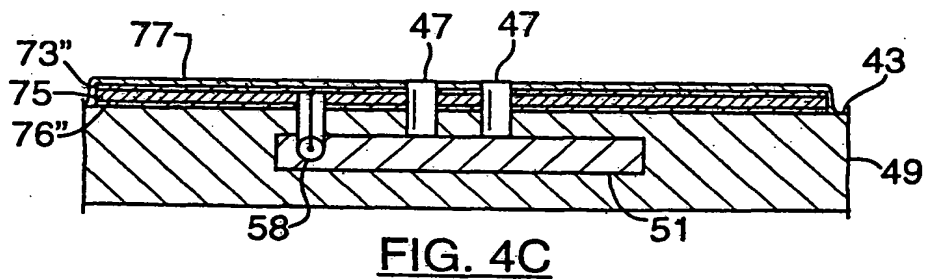
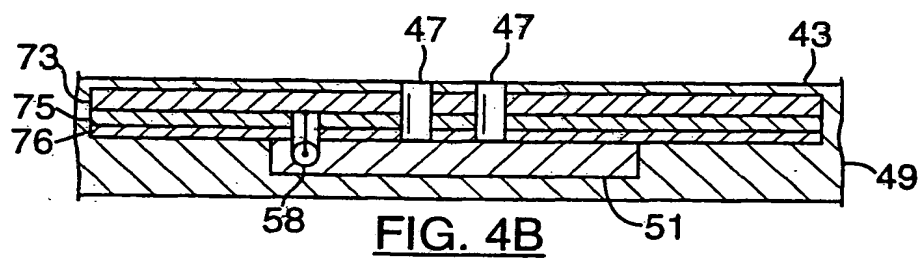
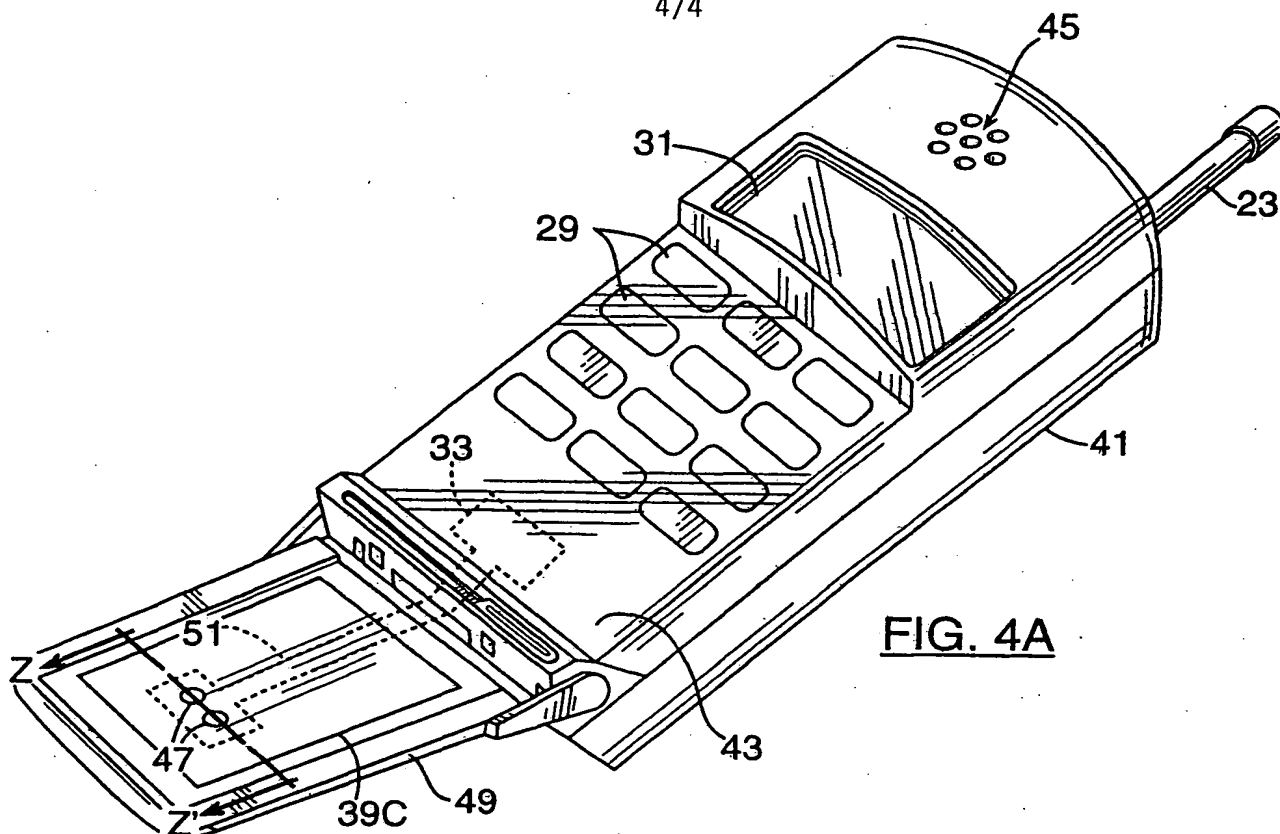
27. A portable radiotelephone according to Claim 26 wherein the global position antenna is a patch antenna including a conductive layer and wherein the desired orientation of the antenna is approximately horizontal.

**FIG. 1**





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# INTERNATIONAL SEARCH REPORT

Inter. Appl. No.  
PCT/US 99/21124

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H04B1/38 H01Q1/24

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H04B H01Q H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 754 942 A (THOMSON CSF) 24 April 1998 (1998-04-24)  page 3, line 10 -page 6, line 3	1-3, 9, 11-14, 20, 22, 23
X	WO 97 26714 A (ERICSSON GE MOBILE INC) 24 July 1997 (1997-07-24) page 5, line 9 -page 7, line 4 page 9, line 3 - line 16 page 10, line 7 - line 20	1, 8-13, 19-23
A	WO 98 09181 A (PHILIPS ELECTRONICS NV ; PHILIPS NORDEN AB (SE)) 5 March 1998 (1998-03-05) page 1, line 5 - line 10 page 2, line 9 - line 13 page 5, line 20 -page 6, line 8 page 7, line 18 - line 25  -/-	1, 13

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

10 March 2000

Date of mailing of the international search report

17. 03. 2000.

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# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 99/21124

## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 752 204 A (CHENNAKESHU SANDEEP ET AL) 12 May 1998 (1998-05-12) column 6, line 47 - column 8, line 56	1, 13
A	US 5 710 987 A (PAULICK THOMAS EUGENE) 20 January 1998 (1998-01-20) column 2, line 12 - line 55 column 4, line 49 - line 53; claims 6-10; figures 4-6	1, 13
A	US 5 410 749 A (SIWIAK KAZIMIERZ ET AL) 25 April 1995 (1995-04-25) column 1, line 55 - column 2, line 8 column 3, line 22 - line 48	1, 13
A	EP 0 774 843 A (GLOBALSTAR LP) 21 May 1997 (1997-05-21) column 3, line 29 - line 37 column 7, line 25 - line 32 column 7, line 47 - line 56 column 9, line 32 - line 47	7, 18, 24, 26
A	WO 97 34381 A (ERICSSON GE MOBILE INC; KARABINIS PETER D (US); DENT PAUL WILKINSO) 18 September 1997 (1997-09-18) claims 1, 33	7, 18, 24, 26



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 99/21124

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-6,8-17,19-23

2. Claims: 7,18,24-27

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/21124

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